

Claims

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1. A microfabricated cell injector comprising an injection wall and projecting from the injection wall a cell injection needle, such that in use cells suspended in a fluid are impelled towards the injection wall and pierced by the injection needle whereupon material is (1) injected into the cell, (2) extracted from the cell, or (3) injected into the cell and then extracted from the cell the steps being in any order and any number of times.
 2. A microfabricated cell injector as claimed in claim 1 further comprising cell propulsion means for impelling cells towards the needle.
 3. A microfabricated cell injector as claimed in claim 1 or 2 wherein the needle is held within a housing defined by the internal surfaces of the microfabricated cell injector, the housing having an inlet for suspended cells to enter and an outlet for cells to exit.
 4. A microfabricated cell injector as claimed in claim 3 wherein a single inlet for cells to enter the housing is also the outlet for cells to exit the housing.
 5. A microfabricated cell injector as claimed in claim 3 wherein the microfabricated cell injector has a number of housings each with at least one needle wherein suspended cells for injection are divided and each divided stream of suspended cells is fed through one housing.
 6. A microfabricated cell injector comprising an internal surface defining a conduit, which in use transports cells suspended in a fluid, the conduit having an inlet and an outlet, the conduit further comprising a cell injection needle, such that, in use cells enter the injector via the inlet, are moved along the conduit and are pierced by the cell injection needle whereupon material is (1) injected into the cell, (2) extracted from the cell, or (3) injected into the cell and then extracted from the cell the steps being in any order and any number of times, and the cells are then moved to the outlet.

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7. A microfabricated cell injector as claimed in ~~any of the above claims~~ ^{Claim 1} where the needle is a hollow structure and injection or extraction is actuated by a cell sensor which determines the presence of a cell on or nearby the needle.

5 8. A microfabricated cell injector as claimed in ~~any of the above claims~~ ^{Claim 1} which additionally comprises a cell capture sensor which determines the presence of a pierced cell on the injection needle and actuates injection of material into the cell or extraction of material from the cell.

10 9. A microfabricated cell injector as claimed in claim 8 wherein the cell capture sensor prevents further cells being impelled towards the needle.

10. A microfabricated cell injector as claimed in claim 8 ~~or 9~~ wherein the cell capture sensor actuates the expulsion of the cell from the needle after injection of the material into the
15 cell or extraction of material from the cell.

11. A microfabricated cell injector as claimed in ~~any of the claims 1 to 6~~ ^{Claim 1} wherein the needle is solid and material for injection is present within the fluid suspending the cells.

20 12. A microfabricated cell injector as claimed in ~~any claim from 1 to 6~~ ^{Claim 1} wherein the needle is a non-cell piercing hollow structure and cell piercing is achieved by the application of a cell disrupting chemical or force through the end of the non-cell piercing needle structure.

13. A microfabricated device containing a plurality of cell injector units as claimed in
25 ~~any of the above claims~~ ^{Claim 1} wherein the respective inlets and outlets of the cell injecting units being each connected such that the cells are divided into each injector unit and recombined after injection.

14. A method for the microinjection of cells which method comprises passing a
30 suspension of cells in a fluid through a conduit comprising a cell injection needle, the cells thereby being pierced by the injection needle and material is: (1) injected into the cell (2)

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extracted from the cell or (3) injected into the cell and then extracted from the cell the steps being in any order and any number of times; as the cells pass through the conduit.

15. A method for the microinjection of cells which method comprises passing a
5 suspension of cells in a fluid through a device as claimed in ^{claim 1} ~~any one of claims 1 to 13~~.

16. Use of a needle which is hollow and substantially circular in cross section, the
external diameter of the needle continuously decreasing as it projects from the base of the
needle to its tip, the tip being less than 25 microns, preferably less than 5 microns, in diameter
10 in the piercing and injecting of material into, or extracting material from, cells.

17. An integrated cell process device which comprises a microfabricated device as
^{claim 1}
15 claimed in ~~any claim from 1 to 13~~ combined with one or more process or analysis steps

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